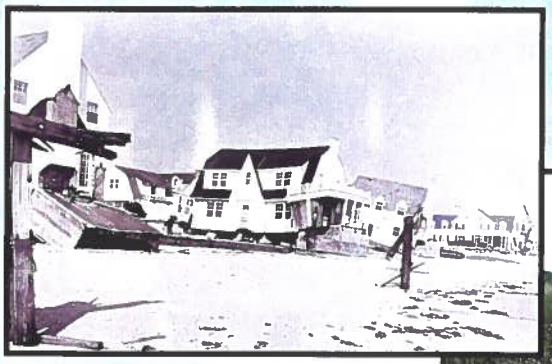
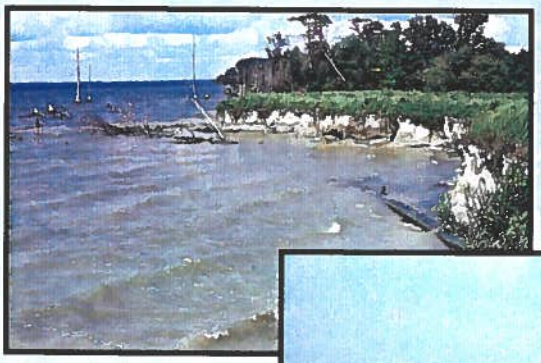
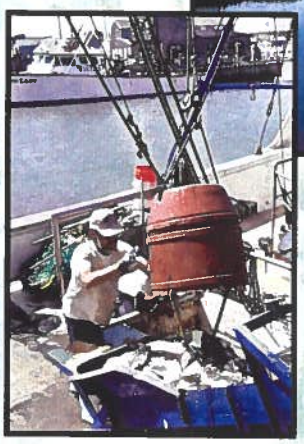
Developing Conservation Plants for USDA Programs: Benefits for Society, Wildlife and the Environment







A Comparison of Benefits and Costs 1965 - 1997

Associated with the

Cape May Plant Materials Center
United States Department of Agriculture
Natural Resources Conservation Service

Foreword

In an attempt to use a new business paradigm for developing a multi-faceted Business Plan, Marketing Plan and set achievable goals for the Cape May Plant Materials Center, a PMC Business Planning Committee was formed. The committee's composition was designed to include policy and field delivery personnel from primary external partner groups such as National Association of Conservation Districts, US Army Corps of Engineers, International Erosion Control Association, Coastal American and others. The committee was also designed to include seasoned NRCS personnel with experience at the Nation, State and Field Office levels.

The first full committee meeting was held in September of 1998. Several major Issues of Concern were generated. This document (Comparison of Benefits to Cost) is in response to one of the Issues of Concern. Though all members contributed to the editorial processes that created this document, one individual contributed far above any other. W. Curtis Sharp, USDA NRCS National Program Manager (retired), graciously contributed of his time and money to travel to the Cape May PMC for the committee meeting. He also exhausted countless ensuing hours contacting people throughout the eastern United States in order to collect and compile reliable data and information; synthesize and establish accurate correlations; organize and table such findings; and develop the report's first draft which served as the architectural framework for this resulting document. Without his generous contributions, steadfast dedication and enduring patience, this benefits to coast analysis may have never come into being. I am grateful to him for this.

William B Skaradek

William Bryan Skaradek
PMC Manager and Team Leader

JOSEPH. L LOMAX
Co-Chair Business Planning Committee/
NACD Northeast Region

GEORGE DAN JONES
Co-Chair Business Planning Committee/
District Conservationist USDA NRCS

Review of Economic Analysis:

The benefit categories were reviewed for appropriateness to affirm that the benefits claimed resulted directly from the products or technical methodologies developed by the Cape May PMC. Costs and benefits were expressed in a common 1997 base year so they were readily comparable. The benefits were based on 1997 price survey data and the costs for the start-up and operation of the Cape may PMC from 1965-1997 were indexed up to 1997 dollars using the Consumer Price Index.

Stephen D. Kemmerle

STEPHEN D. KEMMERLE
Economist USDA NRCS-DE

Table of Contents

Executive Summary 1

Introduction 2

Non-Measurable Qualitative Values 3

Quantitative Data 4

Cost Analysis and Discussion 5

Benefit Analysis and Discussion 6

I. The commercial value of the plant releases 6

II. The measurable economic value of fringe marshes from the Cape May Plant Materials Center products 7

A. Value of developed procedure in establishing marshes and protecting upland acres 8

B. Benefits of the marshes potentially established from the production of the two cordgrass releases 8

III. The measurable benefits of using commercially produced Cape May Plant Materials Center releases to stabilize sand dunes. 8

Study 1: US Army Corps of Engineers. 1997 Ocean Island Beach, North Carolina 10

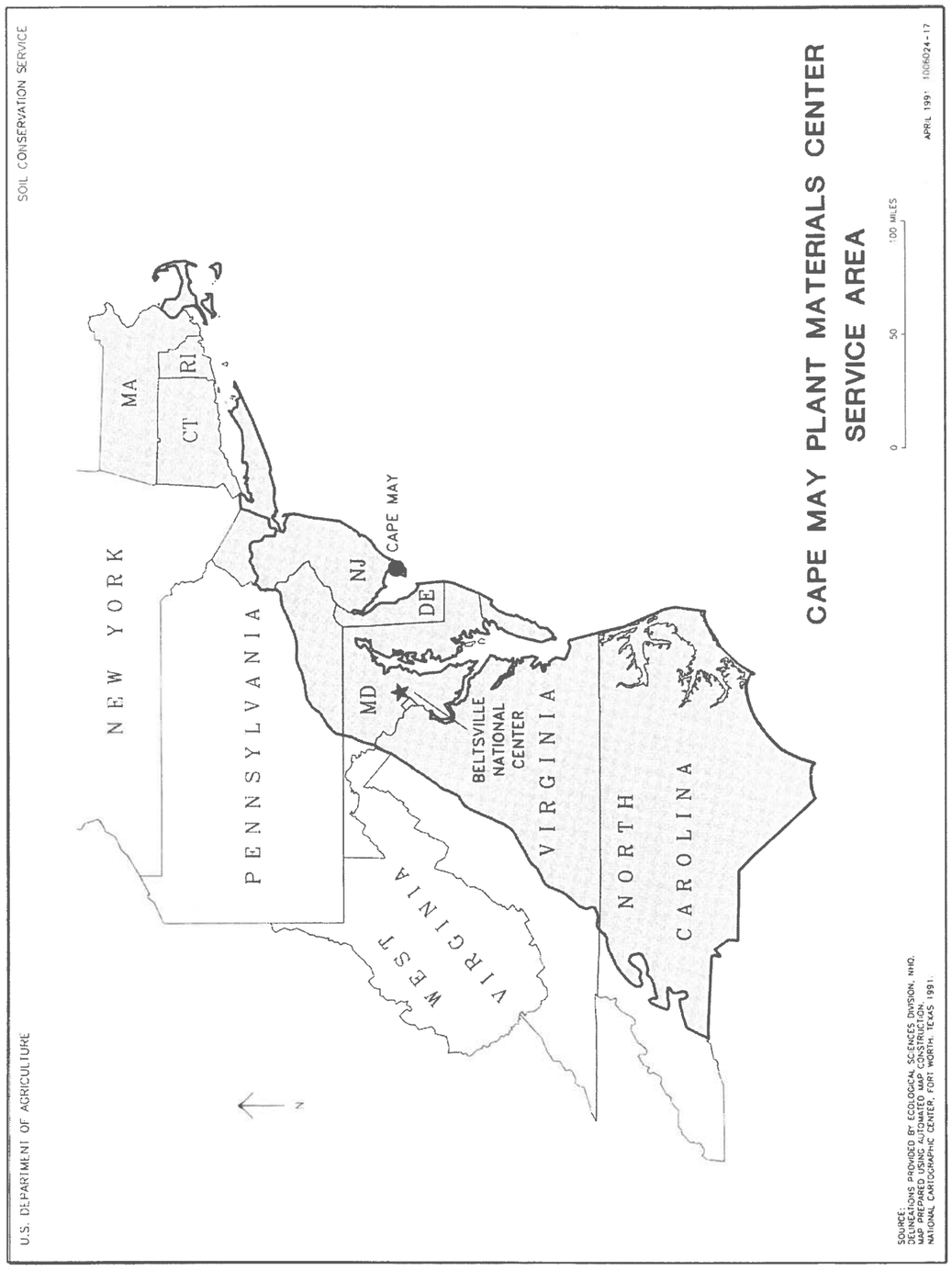
Study 2: US Army Corps of Engineers. 1997. Stone Harbor and Avalon, New Jersey 10

Study 3: US Army Corps of Engineers. Virginia Beach, Virginia 11

Closing 12

References 13

Appendices 15



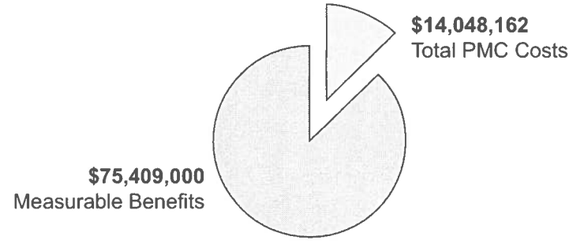
Executive Summary

The Natural Resources Conservation Service (NRCS) Plant Materials Program maintains a network of 26 Plant Materials Centers (PMC) strategically located throughout the U.S. Collectively, their mission is to develop plants and establishment technologies for conservation programs such as: Conservation Reserve Program, Conservation Reserve Enhancement Program, Wildlife Habitat Improvement Program, Environmental Quality Improvement Program and locally identified resource concerns.

The 88th U.S. Congress authorized the establishment of the Cape May PMC in response to a 1962 storm that devastated coastal communities. Primary objectives included Enhancing and Protecting Coastal Dune Resources and Reducing Tidal Shoreline Erosion. The Cape May PMC serves a nine-state area from Massachusetts to North Carolina, which contains over 1,000 miles of coastal shoreline, and the Chesapeake Bay. The tourism industry in five coastal counties of New Jersey alone exceeds ***$25 billion annually.*** People go to the coast primarily for the beaches. The existence of beaches is directly related to the sand budget. The sand budget is a function of stabilized dunes and dunes are stabilized with Cape May PMC plant products.

Recently, our nation's citizenry has developed a new attitude toward the size and cost of government at all levels. This attitude has prompted the examination of the cost effectiveness of government programs. Cost effectiveness is commonly expressed in terms of a benefits to cost ratio statement. An analysis has now been completed using only quantitatively measurable data.

Cape May Plant Materials Center benefits compared to the total costs of establishing and operating the from 1965 until 1997



Measurable PMC Benefits and Total PMC Costs

The Cape May PMC has been successful in producing economic benefits in two high priority areas. Its efforts in these two areas, when compared to all PMC costs, have produced $5.37 in benefits for each $1.00 spent. On reading this report in its entirety, we are sure that you will foster a greater appreciation why developing conservation technologies and products are actually profitable for society and beneficial to wildlife and the environment.

Introduction

The Cape May Plant Materials Center (PMC) was established in response to the coastal storm of 1962 that devastated public and personal properties along the Mid-Atlantic oceanic coastline. During this storm, the protective value of sand dunes was clearly demonstrated. Therefore, the 88th U.S. Congress authorized the establishment of the PMC which opened in 1965. The Cape May PMC, as one integral part of the NRCS Plant Materials Program, addresses resource conservation related issues from a nine-state service area that includes: Massachusetts, Connecticut, Rhode Island, Long Island in New York, New Jersey, Maryland, Delaware, Virginia, and North Carolina. This service area encompasses approximately 99,000 square miles or 63.5 million acres and 123 service centers and field offices. The service area is also home to such major metropolitan areas as Boston, Massachusetts; New York City, New York; Philadelphia, Pennsylvania; Baltimore, Maryland; Washington, DC; Richmond, Virginia; Raleigh, North Carolina and more. As a result, human impact on soil and water resources for housing, industry, commerce, food, fiber and recreation is among the highest in the nation.

The Cape May PMC receives its technical direction from a locally led advisory process. Current field needs are assessed and inventoried at the local Soil and Water Conservation District level. Districts or Field Offices will bring their concerns to the State Plant Material Committee Meetings. Representatives from each state committee will bring their concerns to the Cape May PMC Advisory Committee Meeting. Needs are then prioritized and a technical charge is established. The PMC then develops plant products and related establishment technologies accordingly.

Since its opening in 1965, the Cape May PMC has addressed many diverse resource conservation related issues. For the first 25 years, stabilizing coastal dunes and developing fringe marshes received the greatest attention. Plants, and techniques for using them, were also developed for improving habitat for upland wildlife species and stabilizing areas disturbed by nature or human activities. New USDA conservation programs, such as the Conservation Reserve Program, Conservation Reserve Enhancement Program, Environmental Quality Improvement Program, Wildlife Habitat Improvement Program, and more, have recently generated new needs for additional plant products and related technologies.

In light of these new programs and updated technical needs from State Plant Materials Committees, the Cape May PMC is focusing its staff and equipment resources on developing new plant products for:

- Soil Bioengineering
- Tidal Shoreline Stabilization
- Native Plants (grasses, legumes, forbs, shrubs and trees) for USDA Conservation Programs and other important wildlife habitat programs.
- Native plant establishment technologies.

Non-Measurable Qualitative Values

The plant products that originate from the Cape May PMC have commercial nursery market values that are measurable and have been quantitatively expressed in the following section of this report. However, because these materials are intended for ecological restoration, environmental enhancement, wetland mitigation and erosion protection, there are many qualitative values that are difficult to express in monetary terms. For instance:

Tourism:
The Tourism expenditures are expressed in terms of billions of dollars per year. In New Jersey alone, the five coastal counties generated the following values:

Travel and Tourism Expenditures in Shore Counties

	1996 ($Billion)	1997 ($ Billion)
Atlantic	8.08	8.24
Monmouth	1.57	1.68
Ocean	1.61	1.73
Cape May	2.20	2.32
Cumberland	0.13	0.14
New Jersey	24.05	25.48

Vegetated sand dunes are a part of the natural experience that draws people to the shore. Dunes not only contribute to the aesthetic beauty but also protect valuable properties and infrastructures.

Wildlife Values:

Beach habitats provide three of the four essentials for the survival of many wildlife species that live along the shore: food, cover and living space. Some of the threatened and endangered wildlife species include, but are not limited to, piping plover and the least tern.

Technology Development and Transfer:
Over the years, the Cape May PMC has authored technical guidelines and procedures for successfully getting conservation on the ground. Collectively, the breath of this information is very valuable but not easily quantifiable into monetary terms.

Quantitative Data

Once the PMC was established, work started to select a superior strain of American beachgrass, the initial stabilizer of coastal dunes, and to initiate its commercial production. In 1971 (25), propagating material of '*Cape*' American beachgrass, the first PMC released cultivar, went to commercial growers. Associated with this was the development of needed establishment and management technology (1, 7 and 17).

Fringe marshes protect property by halting erosion, keeping sediment out of tidal streams, contributing to the recycling of nutrients, enhancing shore wildlife habitat, and adding to the aesthetic quality compared to the eroding slope. Erosion at the toe of tidal streams has been an ongoing activity for centuries (14, 18 and 30). As with the sand dunes, fringe marshes come and go, influenced by storms, sediment, and changing stream currents and direction. As land adjacent to these shores was converted to farms or home sites, and boat traffic increased, the erosion became a threatening menace. Additionally, actions by adjacent landowners and stream users aggravated and accelerated the loss of the marshes and prohibited the natural re-invasion of vegetation.

The initial fringe marsh work concentrated on the development of techniques for their establishment. The first results were published in 1970 (15), and refined in subsequent publications (16), followed by the development and release of improved cultivars in 1986 and 1992 (23 and 24).

Plants developed and released as cultivars for the stabilization of coastal dunes and the development of fringe marshes include:

Name	Year	Reference
Cape American beachgrass	1972	USDA, SCS. 1972. Release of *Cape* American Beachgrass. Release Notice: Washington, D. C.
Atlantic coastal panicgrass	1981	Belcher, C.R, W.C. Sharp, R.L. Duell and F.W. Webb. 1982. *Atlantic* Coastal Panicgrass. Crop Sci., Vol. 22, p 1262-63.
Emerald Sea shore juniper	1971	USDA, SCS. 1971. Release of *Emerald Sea* Shore Juniper. Release Notice: Washington, D. C.
Avalon saltmeadow cordgrass	1986	USDA, SCS. 1972. Release of *Avalon* Saltmeadow Cordgrass. Release Notice: Washington, D. C.
Bayshore smooth cordgrass	1992	USDA, SCS. 1972. Release of *Bayshore* Smooth Cordgrass. Release Notice: Washington, D. C.
Wildwood bayberry	1994	USDA, SCS. 1972. *Wildwood* Bayberry. Release Notice: Washington, D. C.
Ocean View beach plum	1994	USDA, SCS. 1972. Release of *Ocean View* Beach Plum. Release Notice: Washington, D. C.
Sandy rugosa rose	1994	USDA, SCS. 1972. Release of *Sandy* Rugosa Rose. Release Notice: Washington, D. C.

The PMC cost analysis is the sum of funds for its establishment and operation. Benefits have been measured and presented for:

I. The commercial value of the plant releases.
II. The measurable economic value of fringe marshes from PMC products.
III. The measurable benefits of using commercially produced Cape May Plant Materials Center releases to stabilize sand dunes.

This Analysis is based on published references or otherwise documented sources, with one exception. This is the increased value to the user of PMC released cultivars for reducing operation and maintenance and major replacement and rehabilitation costs associated with sand dune stabilization, as compared to common strains of the same plants of unknown adaptation and origin. The increased values which are used are low, but were selected to be sure the results of the Analysis are conservative, leaving any margin for potential error to be one of under estimating the benefits of the PMC. Higher values could be justified. For example, there are no other tested cultivars of three of the six PMC releases used for sand dune stabilization, and a fourth, Cape American beachgrass, so dominates the 4 million annual plant market that other beachgrass plants are difficult to locate on the commercial market. The other two are the only cultivars of their species tested for their adaptation to the Mid-Atlantic coastal region. Several additional examples will be found in the Analysis where the potential benefits were deliberately reduced to be sure the results were conservative.

Cost Analysis and Discussion

Costs associated with the PMC are the sum of obligated funds since its establishment. The total of the obligated funds from 1965 through 1997, which have been updated to 1998 values, was $14,048,162. The average annual cost in 1998 dollars was $425,702. These are shown in Table 1.

Table 1 - Total obligations to the Cape May Plant Materials Center

Year	Amount	Year	Amount
		1981	$ 267,049
1997	$ 310,312	1980	$ 245,903
1996	$ 397,470	1979	$ 283,092
1995	$ 435,410	1978	$ 338,530
1994	$ 403,465	1977	$ 312,635
1993	$ 341,087	1976	$ 358,084
1992	$ 353,164	1975	$ 389,019
1991	$ 354,330	1974	$ 435,372
1990	$ 386,912	1973	$ 457,424
1989	$ 292,845	1972	$ 482,172
1988	$ 305,882	1971	$ 552,993
1987	$ 307,629	1970	$ 570,353
1986	$ 284,655	1969	$ 569,550
1985	$ 327,212	1968	$ 587,638
1984	$ 343,120	1967	$ 622,665
1983	$ 382,845	1966	$ 842,619
1982	$ 420,059	1965	$ 1,086,667
Total			**$ 14,048,162**

Some NRCS funds, other than PMC obligated funds, are used by the PMC such as Plant Materials Specialist and Soil Conservationist time in collecting plants. Conversely, PMC funds are used for other NRCS purposes such as administrative offsets that help cover state office salaries. This Analysis assumes that, had the PMC never been established, none of these costs would have occurred, and any costs and/or benefits are confined only to those dollars obligated for its operation.

Benefit Analysis and Discussion

The Benefit Analysis and Discussion section outlines the process used and presents the results and discussions.

I. The commercial value of the plant releases

Records within the NRCS have been kept since 1977 on the estimated commercial production of all released cultivars, with the exception of 1994.

The estimated producer production costs for each of the released cultivars considered in this Analysis are shown in Appendix I. The production costs and consumer prices were determined through conversations with a number of growers, NRCS plant materials personnel and current market prices. Current costs and consumer prices were used for all years. While it is realized that these will vary by year, the high and the low would average themselves out over the years of production. The net profit or loss for each cultivar was computed for each release, then applied to each year in which there was production of that release. These calculations are shown in Appendix II. A summary is shown in Table 2.

Table 2- Commercial production of Cape May Plant Materials Center releases, cost of commercial production and net profit/loss to the producer.

Released Cultivar	Unit	Commercial Production	Producer Cost	Producer Gross	Profit/loss
Cape American beachgrass	culms	123,549,084	$ 2,341,255	$ 5,559,709	$ 3,218,454
Emerald Sea shore juniper	plants	3,825,564	$ 14,957,955	$ 20,466,767	$ 5,508,812
Atlantic coastal panicgrass	seed	44,126	$ 213,570	$ 264,756	$ 51,186
Atlantic coastal panicgrass	plants	5,977,000	$ 3,586,200	$ 6,275,850	$ 2,689,650
Avalon saltmeadow cordgrass	plants	2,741,000	$ 1,644,600	$ 2,878,050	$ 1,233,450
Bayshore smooth cordgrass	plants	104,500	$ 62,700	$ 109,725	$ 47,025
Sandy rugosa rose	plants	4,700	$ 11,327	$ 19,975	$ 8,648
Wildwood bayberry	plants	7,600	$ 18,316	$ 32,300	$ 13,984
Ocean View beach plum	plants	8,050	$ 23,184	$ 56,350	$ 33,166
Grand Total					**$ 12,804,375**

As with any product, if it can be sold at a profit, it will be produced. The most widely produced, and the most effective plant released by the PMC, has been *Cape* American beachgrass. It became available at a time when the value of dunes as protection was beginning to expand. It has performed extremely well and now dominates the market. As the long-term effectiveness of *Atlantic* coastal panicgrass is recognized, its use is also expanding. The cord grasses, which were not available until 1986 and 1992, are becoming more widely used as the cost effectiveness value of coastal fringe marshes is recognized. The shrubs that are adapted to secondary dune stabilization, may never be used extensively, simply because there are fewer and fewer secondary dunes. However, with the emphasis on the use of native ecotypes, the availability of these plants should have continuous and sustained use. Not surprising, the plant with the greatest commercial value, *Emerald Sea* shore juniper, is not the most valuable from an environmental perspective. It is well adapted to the harsh coastal climate, for stabilization as well as ornamental use, thus increasing its total consumption.

The economic benefit realized by all producers of PMC released plants is $1.2 million less than the total establishment and operation costs of the Center: $12,804,375 (benefits) to $14,048,162 (costs).

II. The measurable economic value of fringe marshes from PMC products

The approach used to stabilize tidal shorelines was to determine if a narrow or fringe marsh at the toe of eroding slopes could be established. Initially, PMC work centered on whether fringe marshes could be established artificially to do the same job as naturally occurring marshes, and if so, what were the characteristics of the site where this was possible.

After many trial plantings, procedures were developed which included a process for determining where this technique could be used, and how to make the plantings. Following this, two plants, *Avalon* saltmeadow cordgrass and *Bayshore* smooth cordgrass, were placed in commercial production for this purpose.

All benefits derived from PMC tidal shoreline stabilization work depended on the development of a successful procedure to establish fringe marshes. Two measurements are used to determine these benefits. First, is the use of the procedure with non PMC released plants, followed by the benefits derived from using the procedure to establish PMC released and commercially produced plants. The actual benefits are the value of the renewable ecological goods and services provided by the newly created tidal marshes, based on two separate studies: Gosselink, Odem and Pope, 1974 and Costanza et al. 1997. The per acre per year value calculated by Costanza was $4,043 and by Gosselink from $2,500 to $3,500. This Analysis uses $3,500. Costanza identifies the following goods and services of tidal marshes, and the percent each contributes to the total:

Disturbance regulation - (18%)	Capacitance, dumping and integrity of the marsh to environmental fluctuations. Examples include storm protection and flood control.
Waste treatment - (66%)	Recovery of mobile nutrients and removal or breakdown of excess nutrients and compounds. Examples include waste treatment and pollution control.
Habitat refuge - (2%)	Habitat for resident and transient populations.
Food production - 5%)	The portion of gross primary production extracted as food.
Raw materials - (2%)	The portion of gross primary production extracted as raw materials.
Recreation - (7%)	Providing opportunities for recreational activities.

The renewable goods and ecological services which Costanza assigned to tidal marshes, make no attempt to calculate the value of upland that is protected. Since the purpose of the PMC tidal shoreline stabilization work was to protect the upland property, some additional benefits, not accounted for by Costanza, are realized from the fringe marsh that were established with the PMC developed procedure, and from the production of *Avalon* and *Bayshore*. These are reflected in the following discussions.

A. Value of developed procedure in establishing marshes and protecting upland acres from erosion prior to the release of two cordgrasses.

The following calculations use a modest estimate of 2000 feet per year successfully established since the procedure was published in 1980. Calculations include:

- The renewable ecological goods and services are valued at $3,500/acre/year of marsh established.
- The renewable goods and ecological service and land protected value for 17 years was $378,000.
- Establishment costs were $244,000,
- Total value of 17 years use of the technique was $134,000.
- Additionally, land is protected by the *Avalon* and *Bayshore* plantings. The total land protected by the 182.91 acres equal 205 acres. At $1,500/per acre, the benefit is $308,000. All PMC tidal shoreline efforts are summarized in Table 3.

B. The benefits of marshes potentially established from the production of the two cordgrass releases.

The first measurement considers the per acre value of marshes established from the production of the two cordgrass releases.

The total acres planted with *Avalon* saltmeadow cordgrass and *Bayshore* smooth cordgrass is182, based on their production figures since released of 2,845,500 plants. The net value of the established marsh from *Avalon* and *Bayshore* was $5,050,000.

Table 3 - Summary of impact of the PMC *products on creating marshes and stabilizing tidal shorelines*

Impacts	Gross Benefit
Value of marsh created with *Bayshore* and *Avalon* plants	$5,050,000
Prevention of upland loss and value of marsh by fringe marsh establishment technique, less establishment costs	$ 134,000
Prevention of upland loss with *Bayshore* and *Avalon* plants	$ 308,000
Total Gross Benefit	**$5,492,000**

The value for developing the technique since 1980 of $134,000 is a modest amount. In the absence of reliable data the figure was kept low. Nevertheless, the development of the fringe marshes establishment procedure has allowed over 130 miles of shoreline to be stabilized with a fringe marsh. This Analysis shows the net benefit of the fringe marsh products to be $5,492,000, over one third of the total 33-year PMC budget.

III. The measurable benefits of using commercially produced Cape May Plant Materials Center releases to stabilize sand dunes.

Coastal dunes are nature's way of protecting inland areas, recycling sand that is constantly being moved, and maintaining stability to the coastal zone. During periods between storms sand is moved on shore by tides and waves, swept across the beach by the wind and deposited

on the dune. As such, the dune becomes the banking reservoir until the next storm, which may partially or completely remove the dune sand onto the beach or near shore water. As the storm subsides, the process is repeated; a far less costly and immensely more attractive approach than bulkheads and jetties.

The process of stabilizing coastal dunes in 1965 was partially understood, however, the commercial availability of adapted plants was needed. Six plants have been released by the PMC for use on dunes. The most widely used, *Cape* American beachgrass, is the primary stabilizer of dunes. It persists only where there is active sand movement. As sand moves off the beach into the beachgrass, it is trapped and the dune grows taller (31). At some point, the wind dynamics and the height of the dune will prohibit additional sand from moving over the crest of the dune and the backside becomes a stable environment. All the other plants are used as back or secondary dune stabilizing plants, i.e. they are planted after the beachgrass has stabilized the dune and is beginning to deteriorate. Initially, the beachgrass is planted on an entire dune, and the other released plants are planted only behind the crest of the fore dune.

Due to extensive development along coastal areas, the depth or width of sand dunes along the Mid-Atlantic coast is usually only one dune wide. The seaward side of the dune will remain dynamic, and continually support beachgrass. In a typical fore dune configuration, the seaward side, or fore dune, will represent about 70 percent of the vegetated dune, and the back side about 30 percent. For the purpose of determining benefits of planting PMC released plants on coastal dunes, the life of *Cape* on the fore dune (70 percent of area planted) is calculated at 20 years and on the back dune (30 percent of planted area) at five years. The stabilizing benefits derived from *Cape* are then 15.5 years. The other plants, as shown in Table 4, have a life expectancy of 15 to 20 years.

The released plants, their total commercial production since release, the typical plant spacing for dune plantings, potential failure rate and the resulting acre/years each released plant will stabilize, once established, are shown in Table 4.

Table 4 - Released plants, commercial production, plant spacing, potential failure rate and stabilized acre since release

Plant Releases	Unit	Total Commercial Production	Planting Rate	Plants Used per Acre	Potential Fail Rate	Life Expectancy	Plants Needed per Acre	Total Acres Release Will Plant
Cape American beachgrass	no.	123,549,048	1.5	38,720	35	15.5	52,272	2,364
Emerald Sea shore juniper	no.	3,825,564	3	4,840	40	20	6,776	565
Atlantic coastal panicgrass	lbs	44,126	20	20	60	15	32	1,379
Atlantic coastal panicgrass	no.	5,977,000	1.5	19,360	40	15	27,104	221
Wildwood bayberry	no.	7,600	5	1,742	25	20	2,178	3.49
Ocean View beach plum	no.	8,950	5	1,742	25	20	2,178	4.11
Sandy rugosa rose	no.	4,700	4	2,723	30	20	3,539	1.33
Totals								**4,537**

Measurable benefits of coastal dune plantings made with PMC releases is the reduced operation and maintenance (O&M) costs, and major replacement and rehabilitation (MRR) costs from coastal storm damage. The O&M and MRR costs associated with maintaining dune systems for three US Army Corps of Engineers (Corps) studies form the basis for these calculations. The following points influence the calculations.

- Benefits derived from the Corps projects are based on a life expectancy of 50 years. For this Analysis, the life expectancy of the plants does not exceed 20 years.
- Each PMC plant has fail rate, shown in Table 4, which will require replanting. This fail rate is reflected in the additional costs of the planting.
- All sites are assumed to be planted initially with *Cape* American beachgrass on the entire dune, with the back dune plants dying within five years. The other PMC released plants are used in the back dune area
- The O&M and MRR costs are reduced by 10 percent through the use of PMC plants over common strains of plants of unknown adaptation or origin.

Based on these points, the per acre reduced O&M and MRR benefit has been determined for each of the three Corps studies.

Study 1: Environmental Assessment and Finding of No Significant Impact for Beach Erosion Control and Hurricane Wave Protection, Brunswick County Beaches, North Carolina, Ocean Isle Beach Portion. Wilmington, North Carolina. 1997.

This study includes a beach berm along 3.25 miles of shoreline and 7.4 acres of dunes one mile long and about 65 feet wide. The entire Study has a benefit-cost ratio of 1.9 to 1. The primary benefit is hurricane and storm damage protection.

The average annual project costs for the project are $1,461,000. Total annual O&M costs include beach nourishment ($727,000), monitoring ($44,000) and dune system storm repair, vegetation maintenance and monitoring ($57,000). This translates to $7700 per acre. Using the PMC plants results in a $770 per acre per year benefit over common strains of the same plants of unknown adaptation and origin.

Study 2: New Jersey Shore Protection Plan. 1997. Townsend's Inlet to Cape May Inlet Feasibility Study. Philadelphia, Pennsylvania. 1997.

This Study area encompasses two ocean front communities in Southern New Jersey, Avalon and Stone Harbor. The entire Study has a benefit-cost ratio of 1.8 to 1. The Study components utilized in this Analysis are a berm and dune along 4.3 miles on ocean front, involving 49.5 acres of dunes. The total average annual costs for this project is $5,958,000.

This Study does not include O&M or MRR costs. They have been calculated, based on an average of the Study 1 and Study 3 annual O&M and MRR dune system storm repair, sand replacement and vegetation maintenance costs. The average of these is $788 per acre per year benefit over common strains of the same plants of unknown adaptation and origin.

Study 3: Environmental Assessment and Appendixes. 1994. Beach Erosion Control and Hurricane Protection Study, Virginia Beach, Virginia. Norfolk District, Virginia.

The entire project area protects 6.2 miles of shoreline, consisting of 3.9 miles of seawall, 6.2 miles of beach berm and 2.3 miles, or 25 acres of dunes. The total project benefit-cost ratio is 1.2 to 1. Average annual cost of the project is $11,614,000, with an annual O&M cost of $2,262,500.

Annual dune system storm repair, sand replacement and vegetation maintenance costs, based on the total O&M costs, are estimated to be $201,700, or $8068 per acre. Using the PMC plants results in a $807 per acre per year benefit over common strains of the same plants of unknown adaptation and origin.

Determining Average Benefit

A variety of approaches could be used to resolve an average value to use in the summary from the three Corps Studies. The O&M and MRR benefits per acre varies between the three. By determining this average per acre variation, times the total acres from all three studies gives an objective $792 per acre average benefit. Table 5 shows this summary. A more detailed summary of these calculations is shown in Appendix III.

Table 5 - Average values from the three Corps studies for the PMC releases

Plant Releases	Total Production	Total Acres	Average Value/Year	Average Value Life of Planting
Cape American beachgrass	123,549,048	2,364	$ 1,872,365	$ 29,021,659
Emerald Sea shore juniper	3,825,564	565	$ 447,242	$ 8,944,835
Atlantic coastal panicgrass	44,126	1,379	$ 1,092,358	$ 16,385,364
Atlantic coastal panicgrass	5,977,000	221	$ 174,691	$ 2,620,362
Wildwood bayberry	7,600	3.49	$ 2,764	$ 55,285
Ocean View beach plum	8,950	4.11	$ 3,255	$ 65,105
Sandy rugosa rose	4,700	1.33	$ 1,052	$ 21,040
		4,537	$ 3,593,727	$ 57,113,649

These benefits of $57,114,000 from the PMC dune stabilization efforts are over 4 times the total 33-year PMC budget, or a benefit to cost ratio of 4.14 to 1. Assuming an average dune width of 80 feet, enough plants of the PMC releases have been produced commercially to stabilize 450 miles of dunes. There is every reason to believe that the coastal shores will continue to attract ever increasing numbers of people, and they may have a higher awareness of the value of dunes than anytime in recent history. The plants and technology needed to stabilize them are available, and at no future development costs.

CLOSING

From its establishment in 1965, the PMC has addressed many major missions, which included concentrating on stabilizing coastal dunes and developing fringe marshes to stabilize the toe of eroding tidal streambanks. There are many benefits from multiple PMC missions that cannot be measured. Two measurable areas of evaluations have been used to determine the relationship of the benefit of its operations to the cost of establishing and operating the PMC. In other words, the expressed benefits are only for those things that can be measured from two mission areas while the costs are the sum of all funds for the PMC establishment and operation

This Analysis has produced benefits and costs for each evaluation area. Since the entire life of the PMC has been devoted to the development of benefits, the average annual costs and benefits must reflect its 33-year life. Consequently, Table 6 shows the total benefits and costs and an annual benefits and costs which is the total figure divided by 33 years.

Table 6 - Relationship of the value of benefits to the cost of establishing and operating the PMC

Areas of Evaluation	Gross Values	Annual Values
Cost of establishing and operating CMPMC	$14,048,162	$ 425,702
Benefits to the producer of CMPMC released plants	$12,804,000	$ 388,000
Benefits of fringe marsh plants and technique	$ 5,492,000	$ 166,424
Benefits of sand dune stabilizing plants	$57,113,649	$1,730,717
Total costs	$14,048,162	$ 425,702
Totals benefits	$75,409,649	$2,285,141
Ratio of benefits to cost	5.37	5.37

The Cape May PMC has been successful in producing economic benefits in their assigned area of concentration. Their efforts have produced $5.37 in benefits for each $1.00 spent. This ratio would be significantly larger if all benefits from PMC mission activities could have been incorporated.

References

(1) Augustine, Marshall, and W.C. Sharp. 1966. The Effect of Several Fertilizer Treatments on the Growth of American Beachgrass. Ago. Jou.; 61: 43-5.

(2) Belcher, C.R, W.C. Sharp, R.L. Duell and F.W. Webb. 1981. Registration of '*Atlantic*' Coastal Panicgrass. Crop Sci. V. 22, Nov. - Dec., p 1262-63

(3) Benedict, George Jr. 1998. Personal communications. Co-owner and Manager, Benedict Nurseries, Salisbury, MD

(3,5) County of Cape May, New Jersey. Travel and Tourism Expenditures in Shore Counties.

(4) Costanza, Robert, et al. 1997. The Value of the World's Ecosystem Services and Natural Capital. Nature, May 15, V 387, 253-260.

(5) deButts, Harry. 1998. Personal communications. Director of Public Works, Avalon, NJ

(5.5) Gosselink, J.G., E.P. Odem and R.M. Pope. 1974. The Value of the Tidal Marsh. Center for Wetland Resources, LSU, Baton Rouge. Publ. LSU-SG-74-03.

(6) Hamer, Donald, Cluster Belcher, Chris Miller. 1992. Restoration of Sand Dunes along the Mid-Atlantic Coast. USDA, SCS, Somerset, NJ.

(7) Hawk, V.B. and W.C. Sharp. 1967. Sand Dune Stabilization along the North Atlantic Coast. Jou. Of Soil and Water Cons; Vol. 22, No. 4

(8) Heerden, I. L. 1994. A Long-term Comprehensive Management Plan for Coastal Louisiana to Ensure Sustainable Biological Productivity, Economic Growth, and the Continued Existence of its Unique Culture and Heritage. Center for Coastal Energy and Environmental Resources, Louisiana State Univ., Baton Rouge.

(9) Holloway, Kenneth. 1998. Personal communications. NRCS, Accomac, VA

(10) Materne Michael. 1998. Personal communications. NRCS, Baton Rouge, LA

(11) McMahon, Thomas. 1998. Personal communications. District Manager, Suffolk County Soil and Water Conservation District, Riverhead, NY

(12) National Weather Service. 1992. New Jersey Hurricane Evacuation Study. US Army Corps of Engineers, Phil. District.

(13) Nichols, Bruce. 1998. Personal communications. District Conservationist, NRCS, Ocean City MD

(14) O'Conner, M. D. S. Riggs and V. J. Bellir. 1976. Relative Estuarine shore Erosion Potential in NC. Dept. of Geology and Botany, E. Carolina Univ., Greenville.

(15) Sharp, W. C. and Joseph D. Vaden. 1970. Ten-year Report on Sloping Techniques Used to Stabilize Eroding Tidal River Banks. Shore and Beach; 38:31-5.

(16) Sharp, W.C, C.R. Belcher and J.A. Oyler. 1980. Vegetation for Tidal Stabilization in the Mid-Atlantic States. USDA-SCS, Bromall, PA. 19pp.

(17) Sharp, W.C. and V.B. Hawk. 1975. Establishment of Woody Plants for Secondary and Tertiary Dune Stabilization along the Mid-Atlantic States. International Journal of Biometeorology; 21, 3:245-255.

(18) Singwald, J. T. and T. H. Slaughter. 1949. Shore Erosion in Tidewater Maryland. MD Board of Natural Resources, Dept of Geology, Mines and Water Resources, Baltimore.

(19) USACE. 1994. General Evaluation Report. Main Report. Environmental Assessment and Appendixes. Beach Erosion Control and Hurricane Protection Study, Virginia Beach, VA. Norfolk District, VA

(20) USACE. 1997. New Jersey Shore Protection Plan. Townsends Inlet to Cape May Inlet Feasibility Study. Philadelphia

(21) USACE. 1997. General Evaluation Report. Environmental Assessment and Finding of No Significant Impact for Beach Erosion Control and Hurricane Wave Protection, Brunswick County Beaches, NC, Ocean Isle beach Portion. Wilmington, NC.

(22) USDA, SCS. 1981. Release of *Atlantic* Coastal Panicgrass. Release Notice: The New Jersey Agricultural Experiment Station, New Brunswick, NJ, and the USDA, Soil Conservation Service, Washington, D. C.

(23) USDA, SCS. 1986. Release of *Avalon* Saltmeadow Cordgrass. Release Notice: The New Jersey Agricultural Experiment Station, New Brunswick, NJ, and the USDA, Soil Conservation Service, Washington, D. C.

(24) USDA, SCS. 1992. Release of *Bayshore* Smooth Cordgrass. Release Notice: The New Jersey Agricultural Experiment Station, New Brunswick, NJ, and the USDA, Soil Conservation Service, Washington, D. C.

(25) USDA, SCS. 1972. Release of *Cape* American Beachgrass. Release Notice: The New Jersey Agricultural Experiment Station, New Brunswick, NJ, and the USDA, Soil Conservation Service, Washington, D. C.

(26) USDA, SCS. 1971. Release of *Emerald Sea* Shore Juniper. Release Notice: The New Jersey Agricultural Experiment Station, New Brunswick, NJ, and the USDA, Soil Conservation Service, Washington, D. C.
(27) USDA, SCS. 1994. Release of Ocean View Beach Plum. Release Notice: The New Jersey Agricultural Experiment Station, New Brunswick, NJ, and the USDA, Soil Conservation Service, Washington, D. C.
(28) USDA, SCS. 1994. Release of Sandy Rugosa Rose. Release Notice: The New Jersey Agricultural Experiment Station, New Brunswick, NJ, and the USDA, Soil Conservation Service, Washington, D. C.
(29) USDA, SCS. 1994. Release of *Emerald Sea* Bayberry. Release Notice: The New Jersey Agricultural Experiment Station, New Brunswick, NJ, and the USDA, Soil Conservation Service, Washington, D. C.
(30) Virginia Agri. Exp. Sta. 1962. The Virginia tidal riverbank erosion study. VA Research Rep. 65.
(31) Woodhouse, W. W., Jr. 1978. Dune Building and Stabilization with Vegetation. Coastal Engineering Research Center Special Report No. 3, Ft. Belvoir, VA.

Appendix I – Estimated Producer Production Costs

Cost Item		Unit	Amount	Cost/unit	Cost/acre
Land	Rental Value - 1/	acre	1	$ 90.00	$ 90.00
Field prep - 2/					
	Tractor time @ $15.00/hr	hr	1	$ 15.00	$ 15.00
	Fuel (gal. @ 1.00/gal)	gal	1	$ 1.00	$ 1.00
	Labor.	hr	2	$ 5.25	$ 10.50
Planting of culms - 2/					-
	Culm cost (@ 0.15/culm once each 3 years, and 9680 culms/acre.	ea.	3227	$ 0.15	$ 484.05
	Tractor time @ $15.00/hr	hr	2	$ 15.00	$ 30.00
	Fuel (gal. @ 1.00/gal)	gal	2	$ 1.00	$ 2.00
	Labor.	hr	6	$ 5.25	$ 31.50
Growing season maintenance - 2/					-
	First weeding, irrigation, fertilizing, etc.				-
	Tractor time @ $15.00/hr	hr	0.67	$ 15.00	$ 10.05
	Fuel (gal. @ 1.00/gal)	gal	0.33	$ 1.00	$ 0.33
	Labor.	hr	1	$ 5.25	$ 5.25
	Fertilized/herbicide/water cost	acre	1	$ 60.00	$ 60.00
	2nd weeding, irrigation, fertilizing.				
	Tractor time @ $15.00/hr	hr	1	$ 15.00	$ 15.00
	Fuel (gal. @ 1.00/gal)	gal	0.33	$ 1.00	$ 0.33
	Hours @ $5.25/hr.	hr	1	$ 5.25	$ 5.25
	Fertilized/herbicide/water cost	acre	1	$ 25.00	$ 25.00
	3rd weeding, irrigation, fertilizing.				-
	Tractor time @ $15.00/hr	hr	1	$ 15.00	$ 15.00
	Fuel (gal. @ 1.00/gal)	gal	0.33	$ 1.00	$ 0.33
	Hours @ $5.25/hr.	hr	1	$ 5.25	$ 5.25
	Fertilized/herbicide/water cost	acre	1	$ 80.00	$ 80.00
Harvesting and processing culms - 2/					-
	Tractor time @ $15.00/hr	hr	1	$ 15.00	$ 15.00
	Fuel (gal. @ 1.00/gal)	gal	1	$ 1.00	$ 1.00
	Hours @ $5.25/hr.	hr	378	$ 5.25	$ 1,984.50
	Packing Materials	culm	242,000	0.0010	$ 242.00
	Shipping	mile	150	$ 0.45	$ 67.50
	Certification cost	acre	1	$ 75.00	$ 75.00
Management overhead		hr	5	$ 25.00	$ 125.00
Equipment and facilities prorated to this production		acre	1	$ 1,270.00	$ 1,270.00
	Total Production Cost per Acre				$ 4,665.84
	Total Production Cost per 1000 culms				$ 19.28
	Total cost to produce one culm				0.0193
	Total Cost per planting unit (2 culms)				0.0386

1/ - Rental land values from plant producing areas of NY, NJ, VA and NC.
2/ - Values based on review of growers, actual plant costs, and PMC estimates for their production.

Production costs for 1-0 Bayshore smooth cordgrass

and Avalon saltmeadow cordgrass

Cost Item	Unit	Cost/unit	Sell/ unit	Profit/unit
One gallon pot	each	$ 0.15		
Soil	each	$ 0.09		
Fertilizer	each	$ 0.09		
Irrigation, labor, space, cost of capital, etc.	each	$ 1.07		
Total gallon pot	each	$ 1.40	$ 2.75	$ 1.35
Four inch pot	each	$ 0.11		
Soil	each	$ 0.06		
Fertilized	each	$ 0.05		
Irrigation, labor, space, cost of capital, etc.	each	$ 0.89		
Total four inch	each	$ 1.11	$ 1.75	$ 0.64
Plugs	each	$ 0.04		
Soil	each	$ -		
Fertilizer	each	$ 0.01		
Irrigation, labor, space, cost of capital, etc.	each	$ 0.55		
Total plugs	each	$ 0.60	$ 1.05	$ 0.45
Production = 6 times as many peat pots as 1 gal. and 3 times as many as 4" pots = 1.40+(1.11 x 2) + (.60 x 6)/9 = $.80/plant production costs.				
Average costs/profit all sizes.		$ 0.80	$ 1.57	$ 0.81

Production Costs for One Gallon Containers for:

Wildwood bayberry

Sandy rugosa rose

Cost Item	Unit	Cost/unit	Sell/ unit	Profit/unit
One gallon container	each	$ 0.18		
Soil materials	each	$ 0.11		
Fertilizer	Each	$ 0.09		
Germination, propagation, etc.	Each	0.35		
Irrigation, labor, space, cost of capital, etc.	Each	$ 1.68		
Total gallon container	Each	$ 2.41	$ 4.25	$ 1.84

Production Costs for One Gallon Containers for:

Emerald Sea shore juniper

One gallon container	Each	$ 0.18		
Soil materials	Each	$ 0.11		
Fertilized	Each	$ 0.09		
Germination, propagation, etc.	Each	0.35		
Irrigation, labor, space, cost of capital, etc.	Each	$ 1.68		
Total gallon container/producer	Each	$ 2.41		
Producer markup	each	$ 1.50		
Total gallon container		$ 3.91	$ 5.35	

Production Costs for One Gallon Containers for:

Ocean View beach plum

Cost Item	Unit	Cost/unit	Sell/ unit	Profit/unit
One gallon container	each	$ 0.18		
Soil materials	each	$ 0.11		
Fertilized	each	$ 0.09		
Germination, propagation, etc.	each	0.55		
Irrigation, labor, space, cost of capital, etc.	each	$ 1.95		
Total gallon container	each	$ 2.88	$ 7.50	$ 4.62

Production Costs for Seed of:

Atlantic coastal panicgrass

Cost Item	Unit	Amount	Cost/unit	Cost/acre
Equipment costs pro rated to this production	year	1	$ 500.00	$ 500.00
Field prep - 2/				
Tractor time	hr	1	$ 15.00	$ 15.00
Fuel (gal. @ 1.00/gal	gal	1	$ 1.00	$ 1.00
Labor.	hr	2	$ 5.25	$ 10.50
Planting of seed				-
Seed cost/acre.	lb.	4	$ 5.00	$ 20.00
Tractor time	hr	2	$ 15.00	$ 30.00
Fuel (gal. @ 1.00/gal	gal	1	$ 1.00	$ 1.00
Labor.	hr	2	$ 5.25	$ 10.50
Annual growing season maintenance				$ -
Weeding, irrigation, fertilizing, etc.				$ -
Tractor time	hr	2	$ 15.00	$ 30.00
Fuel (gal. @ 1.00/gal	gal	2	$ 1.00	$ 2.00
Labor.	hr	4	$ 5.25	$ 21.00
Fertilized/herbicide/water cost	acre	1	$ 60.00	$ 60.00
Harvesting and processing seed				-
Combine time @ $15.00/hr	hr	3	$ 25.00	$ 75.00
Fuel (gal. @ 1.00/gal	gal	5	$ 1.00	$ 5.00
Processing seed	hr	15	$ 5.25	$ 78.75
Packaging	lb.	225	0.0300	$ 6.75
Shipping	lb.	225	$ 0.03	$ 6.75
Management overhead	hr	5	$ 25.00	$ 125.00
Cost per acre				$ 998.25
Cost per pound				$ 4.44

1/ - Data based on growing certified seed, life of field not to exceed 6 years, seed production of 150 pounds year 2, 300 pounds years 3, 4, 5 and 6, for an average of 225 pounds/year/acre.

Appendix II – Production and Net Profit/Loss – Cape May PMC Released Cultivars

Cultivar	Year	Commercial Production	Producer cost/1000 culms	Producer price/1000 culms	Profit/loss	Cumulative profit/loss
Cape American beachgrass	1973	110,000	$ 18.95	$ 45.00	$2,866	$2,866
Cape American beachgrass	1974	140,000	$ 18.95	$ 45.00	$3,647	$6,513
Cape American beachgrass	1975	165,000	$ 18.95	$ 45.00	$4,298	$10,811
Cape American beachgrass	1976	175,000	$ 18.95	$ 45.00	$4,559	$15,370
Cape American beachgrass	1977	211,000	$ 18.95	$ 45.00	$5,497	$20,867
Cape American beachgrass	1978	1,920,000	$ 18.95	$ 45.00	$50,016	$70,883
Cape American beachgrass	1979	1,985,000	$ 18.95	$ 45.00	$51,709	$122,592
Cape American beachgrass	1980	2,140,000	$ 18.95	$ 45.00	$55,747	$178,339
Cape American beachgrass	1981	6,185,000	$ 18.95	$ 45.00	$161,119	$339,458
Cape American beachgrass	1982	7,359,000	$ 18.95	$ 45.00	$191,702	$531,160
Cape American beachgrass	1983	9,375,000	$ 18.95	$ 45.00	$244,219	$775,379
Cape American beachgrass	1984	6,625,000	$ 18.95	$ 45.00	$172,581	$947,960
Cape American beachgrass	1985	5,131,000	$ 18.95	$ 45.00	$133,663	$1,081,623
Cape American beachgrass	1986	5,165,000	$ 18.95	$ 45.00	$134,548	$1,216,171
Cape American beachgrass	1987	4,724,520	$ 18.95	$ 45.00	$123,074	$1,339,245
Cape American beachgrass	1988	7,752,000	$ 18.95	$ 45.00	$201,940	$1,541,184
Cape American beachgrass	1989	9,552,000	$ 18.95	$ 45.00	$248,830	$1,790,014
Cape American beachgrass	1990	10,782,000	$ 18.95	$ 45.00	$280,871	$2,070,885
Cape American beachgrass	1991	5,291,000	$ 18.95	$ 45.00	$137,831	$2,208,715
Cape American beachgrass	1992	4,147,500	$ 18.95	$ 45.00	$108,042	$2,316,758
Cape American beachgrass	1993	23,850,000	$ 18.95	$ 45.00	$621,293	$2,938,050
Cape American beachgrass	1994	*2,500,000*	$ 18.95	$ 45.00	$65,125	$3,003,175
Cape American beachgrass	1995	759,064	$ 18.95	$ 45.00	$19,774	$3,022,949
Cape American beachgrass	1996	3,880,000	$ 18.95	$ 45.00	$101,074	$3,124,023
Cape American beachgrass	1997	3,625,000	$ 18.95	$ 45.00	$94,431	$3,218,454
Emerald Sea shore juniper	1977	5500	$ 3.91	$ 5.35	$7,920	$7,920
Emerald Sea shore juniper	1978	20925	$ 3.91	$ 5.35	$30,132	$38,052
Emerald Sea shore juniper	1979	20930	$ 3.91	$ 5.35	$30,139	$68,191
Emerald Sea shore juniper	1980	28290	$ 3.91	$ 5.35	$40,738	$108,929
Emerald Sea shore juniper	1981	50096	$ 3.91	$ 5.35	$72,138	$181,067
Emerald Sea shore juniper	1982	144313	$ 3.91	$ 5.35	$207,811	$388,878
Emerald Sea shore juniper	1983	45635	$ 3.91	$ 5.35	$65,714	$454,592
Emerald Sea shore juniper	1984	149000	$ 3.91	$ 5.35	$214,560	$669,152
Emerald Sea shore juniper	1985	265575	$ 3.91	$ 5.35	$382,428	$1,051,580
Emerald Sea shore juniper	1986	280250	$ 3.91	$ 5.35	$403,560	$1,455,140
Emerald Sea shore juniper	1987	283000	$ 3.91	$ 5.35	$407,520	$1,862,660
Emerald Sea shore juniper	1988	290700	$ 3.91	$ 5.35	$418,608	$2,281,268
Emerald Sea shore juniper	1989	295000	$ 3.91	$ 5.35	$424,800	$2,706,068
Emerald Sea shore juniper	1990	300650	$ 3.91	$ 5.35	$432,936	$3,139,004
Emerald Sea shore juniper	1991	280700	$ 3.91	$ 5.35	$404,208	$3,543,212
Emerald Sea shore juniper	1992	256000	$ 3.91	$ 5.35	$368,640	$3,911,852
Emerald Sea shore juniper	1993	322000	$ 3.91	$ 5.35	$463,680	$4,375,532
Emerald Sea shore juniper	1994	200000	$ 3.91	$ 5.35	$288,000	$4,663,532
Emerald Sea shore juniper	1995	287000	$ 3.91	$ 5.35	$413,280	$5,076,812
Emerald Sea shore juniper	1996	150000	$ 3.91	$ 5.35	$216,000	$5,292,812
Emerald Sea shore juniper	1997	150000	$ 3.91	$ 5.35	$216,000	$5,508,812

Cultivar	Year	Commercial Production (LB)	Producer cost/LB	Producer price/LB	Profit/loss	Cumulative Profit/loss
Atlantic coastal panicgrass	1984	600	$ 4.84	$ 6.00	$696	$696
Atlantic coastal panicgrass	1985	3680	$ 4.84	$ 6.00	$4,269	$4,965
Atlantic coastal panicgrass	1986	2500	$ 4.84	$ 6.00	$2,900	$7,865
Atlantic coastal panicgrass	1987	2500	$ 4.84	$ 6.00	$2,900	$10,765
Atlantic coastal panicgrass	1988	1250	$ 4.84	$ 6.00	$1,450	$12,215
Atlantic coastal panicgrass	1989	4900	$ 4.84	$ 6.00	$5,684	$17,899
Atlantic coastal panicgrass	1990	8600	$ 4.84	$ 6.00	$9,976	$27,875
Atlantic coastal panicgrass	1991	10921	$ 4.84	$ 6.00	$12,668	$40,543
Atlantic coastal panicgrass	1992	2000	$ 4.84	$ 6.00	$2,320	$42,863
Atlantic coastal panicgrass	1993	3675	$ 4.84	$ 6.00	$4,263	$47,126
Atlantic coastal panicgrass	1994	0	$ 4.84	$ 6.00	$0	$47,126
Atlantic coastal panicgrass	1995	1100	$ 4.84	$ 6.00	$1,276	$48,402
Atlantic coastal panicgrass	1996	1200	$ 4.84	$ 6.00	$1,392	$49,794
Atlantic coastal panicgrass	1997	1200	$ 4.84	$ 6.00	$1,392	$51,186
*note 1998 Market prices for	'Atlantic'	was between	$15-20 per Lb.			
Atlantic coastal panicgrass	1984	250000	$ 0.60	$ 1.05	$112,500	$112,500
Atlantic coastal panicgrass	1985	1200	$ 0.60	$ 1.05	$540	$113,040
Atlantic coastal panicgrass	1986	162000	$ 0.60	$ 1.05	$72,900	$185,940
Atlantic coastal panicgrass	1987	225000	$ 0.60	$ 1.05	$101,250	$287,190
Atlantic coastal panicgrass	1988	210000	$ 0.60	$ 1.05	$94,500	$381,690
Atlantic coastal panicgrass	1989	212000	$ 0.60	$ 1.05	$95,400	$477,090
Atlantic coastal panicgrass	1990	2330000	$ 0.60	$ 1.05	$1,048,500	$1,525,590
Atlantic coastal panicgrass	1991	260000	$ 0.60	$ 1.05	$117,000	$1,642,590
Atlantic coastal panicgrass	1992	615500	$ 0.60	$ 1.05	$276,975	$1,919,565
Atlantic coastal panicgrass	1993	705500	$ 0.60	$ 1.05	$317,475	$2,237,040
Atlantic coastal panicgrass	1994	300000	$ 0.60	$ 1.05	$135,000	$2,372,040
Atlantic coastal panicgrass	1995	590000	$ 0.60	$ 1.05	$265,500	$2,637,540
Atlantic coastal panicgrass	1996	100800	$ 0.60	$ 1.05	$45,360	$2,682,900
Atlantic coastal panicgrass	1997	15000	$ 0.60	$ 1.05	$6,750	$2,689,650
Avalon saltmeadow cordgrass	1987	40000	$ 0.60	$ 1.05	$18,000	$32,400
Avalon saltmeadow cordgrass	1988	142000	$ 0.60	$ 1.05	$63,900	$96,300
Avalon saltmeadow cordgrass	1989	172000	$ 0.60	$ 1.05	$77,400	$173,700
Avalon saltmeadow cordgrass	1990	177000	$ 0.60	$ 1.05	$79,650	$253,350
Avalon saltmeadow cordgrass	1991	562000	$ 0.60	$ 1.05	$252,900	$506,250
Avalon saltmeadow cordgrass	1992	305000	$ 0.60	$ 1.05	$137,250	$643,500
Avalon saltmeadow cordgrass	1993	570000	$ 0.60	$ 1.05	$256,500	$900,000
Avalon saltmeadow cordgrass	1994	*200000*	$ 0.60	$ 1.05	$90,000	$990,000
Avalon saltmeadow cordgrass	1995	227000	$ 0.60	$ 1.05	$102,150	$1,092,150
Avalon saltmeadow cordgrass	1996	244500	$ 0.60	$ 1.05	$110,025	$1,202,175
Avalon saltmeadow cordgrass	1997	101500	$ 0.60	$ 1.05	$45,675	$1,247,850

Appendix II – Production and Net Profit/Loss – Cape May PMC Released Cultivars (cont.)

Cultivar	Year	Commercial Production	Producer Cost/PLT	Producer price/PLT	Profit/loss	Cumulative Profit/loss
Bayshore smooth cordgrass	1992	2500	$ 0.60	$ 1.05	$1,125	$1,125
Bayshore smooth cordgrass	1993	0	$ 0.60	$ 1.05	$0	$1,125
Bayshore smooth cordgrass	1994	10000	$ 0.60	$ 1.05	$4,500	$5,625
Bayshore smooth cordgrass	1995	65000	$ 0.60	$ 1.05	$29,250	$34,875
Bayshore smooth cordgrass	1996	27000	$ 0.60	$ 1.05	$12,150	$47,025
Sandy rugosa rose	1993	400	$ 2.41	$ 4.25	$736	$736
Sandy rugosa rose	1994	500	$ 2.41	$ 4.25	$920	$1,656
Sandy rugosa rose	1995	500	$ 2.41	$ 4.25	$920	$2,576
Sandy rugosa rose	1996	2000	$ 2.41	$ 4.25	$3,680	$6,256
Sandy rugosa rose	1997	1300	$ 2.41	$ 4.25	$2,392	$8,648
Wildwood bayberry	1993	500	$ 2.41	$ 4.25	$920	$920
Wildwood bayberry	1994	500	$ 2.41	$ 4.25	$920	$1,840
Wildwood bayberry	1995	500	$ 2.41	$ 4.25	$920	$2,760
Wildwood bayberry	1996	1000	$ 2.41	$ 4.25	$1,840	$4,600
Wildwood bayberry	1997	5100	$ 2.41	$ 4.25	$9,384	$13,984
Ocean View beach plum	1993	150	$ 2.88	$ 7.00	$618	$618
Ocean View beach plum	1994	400	$ 2.88	$ 7.00	$1,648	$2,266
Ocean View beach plum	1995	400	$ 2.88	$ 7.00	$1,648	$3,914
Ocean View beach plum	1996	5300	$ 2.88	$ 7.00	$21,836	$25,750
Ocean View beach plum	1997	1800	$ 2.88	$ 7.00	$7,416	$33,166

Appendix III

Summary of impacts of the PMC on stabilizing coastal dunes

A summary of the per acre benefits, and the yearly and lifetime benefits of the PMC released plants for sand dune stabilization is shown in the Table below.

Value of Cape May PMC released plants, based on three Corps Studies.

Plant Releases	Unit	Total Production	Total Acres	Value CMPMC Plts/Acre/year Study #1 = $770	Study #2 = $788	Study #3 $807	=	Value CMPMC Plts/LE years Study #1	Study #2	Study #3
Cape American beachgrass	no.	123,549,048	2,364	$ 1,819,957	$ 1,862,501	$ 1,907,409		$ 28,209,326	$ 28,868,765	$ 29,564,839
Emerald Sea shore juniper	no.	3,825,564	565	$ 434,723	$ 444,886	$ 455,612		$ 8,694,464	$ 8,897,711	$ 9,112,250
Atlantic coastal panicgrass	lbs.	44,126	1,379	$ 1,061,782	$ 1,086,603	$ 1,112,803		$ 15,926,728	$ 16,299,041	$ 16,692,038
Atlantic coastal panicgrass	no.	5,977,000	221	$ 169,801	$ 173,771	$ 177,960		$ 2,547,017	$ 2,606,558	$ 2,669,406
Wildwood bayberry	no.	7,600	3.49	$ 2,687	$ 2,750	$ 2,816		$ 53,737	$ 54,994	$ 56,320
Ocean View beach plum	no.	8,950	4.11	$ 3,164	$ 3,238	$ 3,316		$ 63,283	$ 64,762	$ 66,324
Sandy rugosa rose	no.	4,700	1.33	$ 1,023	$ 1,046	$ 1,072		$ 20,451	$ 20,929	$ 21,433
Totals			4,537	$ 3,493,136	$ 3,574,794	$ 3,660,988		$ 55,515,006	$ 56,812,759	$ 58,182,610

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, sexual orientation, or marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326W, Whitten Building, 14th and Independence Avenue, SW, Washington, D.C. 20250-9410 or call 202-720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.